

### Life History and Background Information on the Chinese Mitten Crab

The Chinese mitten crab (*Eriocheir sinensis*), so named for the dense patches of hairs on the claws of larger juveniles and adults, is native to the coastal rivers and estuaries of the Yellow Sea. It was accidentally introduced to Germany in the early 1900s and spread to many northern European rivers and estuaries. In the San Francisco Estuary, the mitten crab was first collected in 1992 by commercial shrimp trawlers in South San Francisco Bay and has since spread rapidly throughout the estuary. Mitten crabs were first collected in San Pablo Bay in fall 1994, Suisun Marsh in February 1996, and the Delta in September 1996. As of September 1998, the known distribution of the Chinese mitten crab extends north of Delevan National Wildlife Refuge (Hunter's Creek) in the Sacramento River drainage and just north of Marysville (Jack Slough) in the Feather River drainage, east to Roseville (Cirby Creek) and eastern San Joaquin County near Calaveras County (Mormon Slough and Littlejohns Creek) and south in the San Joaquin River to Hiway 165, near San Luis National Wildlife Refuge.

The most probable mechanism of introduction to the estuary was either deliberate release to establish a fishery or accidental release via ballast water. In Asia, the mitten crab is a delicacy - mature females, with bright orange ovaries, command the highest price. In response to finding live mitten crabs offered for sale in markets in Los Angeles and San Francisco in 1985, DFG added crabs of the genus *Eriocheir* to the List of Prohibited Species (Section 671, Title 14) in 1986 and requested that USFWS add the genus to their list of injurious wildlife (USFWS did so in 1988). The mitten crab was undoubtedly introduced several years prior to the first reported collections in 1992.

The mitten crab is catadromous - adults reproduce in salt water and juveniles migrate to fresh water to rear. In the San Francisco Estuary, the mitten crab probably matures in 2 to 3 years, although it reportedly matures from 1 to 5 years elsewhere, depending on water temperature. Males and females grow to a maximum carapace width of approximately 80 mm (3 inches) in the estuary. Mating and fertilization occurs in late fall and winter, generally at

salinities  $> 15\text{‰}$  (ocean salinities are approximately  $34\text{‰}$ ). A single female can produce 250,000 to 1 million eggs, but only reproduces once. Females carry the eggs until hatching and both sexes die soon after reproduction. After hatching, larvae are planktonic for approximately 1 to 2 months. The small juvenile crabs settle in salt or brackish water in late spring and migrate to brackish or freshwater over several months.

In their first year, juvenile mitten crabs are found in tidal brackish and freshwater areas ( $< 2\text{-}3\text{‰}$ ), and often burrow in banks and levees between the high and low tide marks. In South Bay tributaries, age-0 mitten crabs were most abundant in areas with steep, near vertical, clay banks lined with vegetation. Mitten crabs apparently do not burrow as extensively in non-tidal areas, probably because they are not subject to desiccation during low tides. We have recently received the first reliable report of mitten crab burrows upstream of the Delta (Merced County), and as the mitten crab population grows, undoubtedly more mitten crab burrows will be confirmed.

Older juveniles are found further upstream than younger juveniles, and in China and Europe they have been reported several hundred miles from the sea. This past February and March, thousands of age-1 mitten crabs (25-40 mm CW) migrated upstream of the Delta to rearing areas in the Central Valley. Although we do not know what cues this upstream migration, in Germany it corresponded with increasing temperatures. Through summer, most of the age-1 crabs in the Central Valley were reported from relatively shallow, warm waters (e.g. Colusa Drain, Sutter Bypass), rather than the larger, relatively cool rivers. Maturing crabs move from shallow areas to the channels in late summer and early fall and migrate to salt water in late fall and early winter to complete the life cycle. Males migrate before females and, based on observations from 1997, peak migration through the Delta is in early October. In Germany, juvenile mitten crabs traveled 2-3 km (1.2-1.9 miles) per day during their upstream migration while adult crabs traveled up to 12 km (7.5 miles) per day during their downstream migration.

Mitten crabs are adept walkers on land, and, in their migrations, they readily move across banks or levees to bypass obstructions, such as dams or weirs. In Germany, large numbers of mitten crabs were reported to leave the water at night when they encountered an obstruction and occasionally wandered the streets and entered houses. In Stockton, 2 adult mitten crabs climbed over a levee and into a swimming pool when they encountered a small dam blocking their downstream migration in fall 1997. We have also received several reports of mitten crab on roadways and in parking lots and backyards.

Mitten crabs are omnivores, with juveniles eating mostly vegetation; mitten crabs become more carnivorous with age and have been reported to prey upon bivalves, gastropods, polychaetes, amphipods, insects, shrimp, and small fishes. Maturing and adult crabs have been incidentally caught by anglers using a variety of bait, ranging from ghost shrimp to shad, reflecting their carnivorous food habits. Reported predators of the mitten crab include white sturgeon, striped bass, channel catfish, bullfrog, common loon, and egrets. We assume that other predatory fishes, including largemouth bass and larger sunfishes, river otters, racoons, and other wading and diving birds also consume mitten crabs.

Based on the mitten crab's impacts in its native range and Europe, it poses several possible threats in California. In Asia, the mitten crab is the secondary intermediate host for the Oriental lung fluke, with mammals, including humans, as the final host. Humans become infested by eating raw or pickled mitten crabs or during the preparation of raw crabs, when cutting utensils and hands may become contaminated. To date, neither the lung fluke nor any of the freshwater snails that serve as the primary intermediate host for the fluke in Asia have been found in the estuary. However, only 25 crabs were examined for the parasite several years ago and it has been noted that several species of freshwater snails which could possibly serve as an intermediate host are present in the watershed.

The burrowing activity of mitten crabs may accelerate the erosion of banks and levees. In Germany, burrows were reported to be up to 50 cm (20 inches) deep, with some damage to

banks and levees and undermining of structures. Mitten crab burrow densities as high as 30/m<sup>2</sup> (2.7/ft<sup>2</sup>) have been reported from South Bay creeks, with most burrows no more than 20-30 cm (8-12 inches) deep. The highest density of juvenile crabs was approximately 6/m<sup>2</sup> (0.8/ft<sup>2</sup>) in Suisun Marsh and 1/m<sup>2</sup> (0.1/ft<sup>2</sup>) in the Delta in summer 1997, although not all crabs were found in burrows (preliminary data indicates densities were very similar in summer 1998). In the Delta, juvenile mitten crabs have been also found in water hyacinth and *Egeria densa*, a rooted plant which grows beneath the water's surface and forms dense beds.

In China and Korea, juvenile mitten crabs have been reported to damage rice crops by consuming the young rice shoots and burrowing in the rice field levees. Rice fields in tidally influenced areas apparently are most subject to damage. It is possible that California rice fields, which are dry for a portion of the year, may suffer less damage by the mitten crab than in Asia, where water reportedly is on many fields year-round.

To date, the most severe impact in California has been the interference by out-migrating adult mitten crabs with fish salvage operations at the USBR and DWR pumping facilities in the south Delta. In fall 1997, large numbers of crabs first became a nuisance at these facilities, but in fall 1998, numbers increased substantially such that the crabs interfered with the ability to effectively salvage fish. From early September through early October 1998, 10,000 to 20,000 mitten crabs per day were reported by USBR and up to 10,000 crabs per day by DWR at their facilities, hindering facility and salvage operations from the trash racks to the fish transport trucks. In contrast, only 25 crabs were reported from both facilities in 1996 (numbers collected not expanded by the amount of water pumped) and approximately 17,000 crabs were reported by USBR in fall 1997 (numbers collected expanded by the amount of water pumped). PG&E also reported that the Pittsburg Power Plant, located on the southern shore of Suisun Bay, was affected by high numbers of adult crabs in fall 1997. Workers noticed reduced flows in the cooling water system and, upon back-flushing, found the internal piping had been partially clogged with hundreds of crabs.

The most widely reported economic impact of mitten crabs in Europe has been damage to commercial fishing nets and the catch when the crabs are caught in high numbers. The mitten crab has become a nuisance for commercial Bay shrimp trawlers in South Bay, as it is time consuming to remove the crabs from the nets (one trawler has reported catching over 200 crabs in a single tow several times). Shrimp trawlers have also reported that a large catch of mitten crabs damages and even kills the shrimp, making them unsuitable for the bait market. Shrimp trawlers have been able to move to areas with fewer crabs, but, as the mitten crab population grows, this option diminishes.

The mitten crab overlaps in dietary and habitat preferences with the introduced red swamp crayfish (*Procambarus clarkii*) and negative interactions between the two species have been observed in South San Francisco Bay creeks. In the Delta, the mitten crab may reduce abundance and growth rates of the introduced signal crayfish (*Pacifastacus leniusculus*), which supports a commercial fishery. The mitten crab may also seasonally displace crayfish from the baited traps used by this fishery.

The ecological impact of a large mitten crab population is the least understood of all the potential impacts. Although juveniles primarily consume vegetation, maturing and adult crabs prey upon animals, especially invertebrates, as they grow. A large mitten crab population could reduce invertebrate populations and change the structure of the estuary's fresh and brackish water benthic communities. These food web changes could be reflected in the abundance and growth rates of other species, including fishes, which also prey upon these benthic invertebrates.

In Germany, extensive efforts were undertaken by the government in the 1920s and 1930s to control mitten crab populations in some rivers. Control measures often took advantage of the mitten crab's migratory behavior; to capture upstream migrating juveniles, traps were placed on the upstream side of dams, or, if the dam was impassible, the crabs were collected in trenches which were dug parallel to the river banks. At one site, as many as

113,960 crabs were collected over 24 hours. It was hypothesized that this population explosion may have coincided with a reduction of predators, especially fishes, in the rivers. In recent years, European mitten crab populations have apparently been stable, although there are occasional reports of "invasions" (most recently in the River Thames in England). In 1981, the mitten crab population in the Netherlands increased substantially, resulting in serious damage to fishing nets.

Information on the impacts of the mitten crab in China and Korea has been more difficult to obtain. Although the mitten crab damages rice crops, no control measure have been reported. In some rice fields, they are cultured with fish. Apparently, mitten crabs are stocked at a rate that does not damage the rice crop.

*Note: It is illegal to import, transport, or possess live Chinese mitten crabs (Title 14, Section 671 of the California Code of Regulations). Accidental release or escape will spread these crabs to uninfested waters. If you keep a mitten crab, it must be dead. There are no bag or size limits for mitten crabs.*

For additional Chinese mitten crab information, please visit our web site:  
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